CRUISE RESULTS
Chartered Vessel Cruise No. 99-1
F/V *Hickory Wind*

Flexible Grate for Pollock Size Selection

A 12 day cruise to make observations of walleye pollock behavior
in the vicinity of trawls aboard the chartered vessel *Hickory
Wind* commenced in Kodiak, Alaska on May 17, 1999. This cruise
continued a project to facilitate the development of more
selective midwater trawls to reduce the catch of undersized
pollock. The selectivity of fishing gear results from the
interactions between fish and the stimuli presented by the
fishing gear. Underwater video systems were used to observe
pollock reactions to a flexible grate installed in the extension
section of a midwater trawl. An auxiliary net was used to
capture the fish which exited the trawl through the grate, thus
allowing quantitative analysis of the resulting size selection.
An infrared video system was used to observe variations in fish
behavior at low light levels.

AREA OF OPERATIONS AND ITINERARY

All research trawling was conducted off the eastern shore of
Kodiak Island, Alaska. Trawl locations were selected for
likelihood of encountering walleye pollock *(Theragra
chalcogramma)* schools.

May 17	Loaded vessel
May 16 – 28	Field operations near Kodiak
May 29	Unloaded vessel

OBJECTIVES

1.   The characteristics of flexible grates to achieve escape of
     undersized fish were tested, including:

    a. ability of the grate system to maintain configuration
       after multiple deployments from a net storage reel,

    b. size selection of pollock when grate is installed in the
       trawl extension section, and

    c. the effects of different bar spacings and auxiliary
       components on size selection.

METHODS

Intensified CCD cameras (ICCD) with high sensitivity in the
infrared range were used with infrared LED illuminators to
observe pollock behavior. While the rapid absorption of infrared
light by water limited the range of this combination, the
insensitivity of fish vision to infrared light made observation
possible while providing minimal illumination for the subject
fish. Batteries and a video recorder in an underwater housing
were connected to fixed camera and light mountings to provide
power and record the video output. These systems were started
when the trawl was launched and operated throughout the trawl
tow.

The principal study trawl was a commercial four-panel midwater
trawl with headrope and footrope lengths of 93.6 m and breastline
lengths of 83.4 m. It was fished behind 5.5 m^2 steel midwater
trawl doors. Towing speeds varied between 3 and 4 knots and the
ship's positions, based on GPS (Global Positioning System)fixes,
were recorded at one minute intervals throughout each tow.
Temperature, light level and depth were recorded with a data
logging sensor on the headrope.

The flexible grates consisted of 25 fiberglass rods 234 cm (7.7
ft) long and 11 mm (0.5 in) in diameter, held together by 1.9 cm
(.75 inch) inside diameter synthetic rubber automotive heater
hose (Goodyear Horizon[1]) with holes at constant intervals to
regulate the width of the gaps between the bars. The hose
divided the length of the bars into 6 sections, each about 36 cm
(14 in) long. Spacing between the bars was 53 mm for two of the
grates and 51 mm for the third. Thicker fiberglass rods (1.6 cm
diam, 5/8 in) were affixed across the forward and aft ends of the
grate to keep it spread. Fiberglass and rubber were used in the
design and construction to allow the grate to bend to wrap onto a
net storage reel and then return to a consistent configuration
when the net was again set.

The grate was installed angling through the trawl extension with
the forward edge attached to the top panel of the extension and
the sides of the grate tied along a descending bar of the mesh.

Fish that did not go through the grate had to pass through a small opening between the aft (lower) edge of the grate and the lower panel of the extension. A mesh panel was installed ahead of the grate, forming an inverted V above the bottom of the extension. This deflection panel forced fish higher, to encounter the forward portion of the grate before they could pass through the gap at its aft edge. The top point of the deflection panel was supported by either three 8-inch diameter floats or elastic stretch cords connected to the upper riblines of the extension.

Initial tests were made on a visual method for encouraging pollock to move higher before encountering the grate. Electroluminescent wire (Live Wire Enterprises[1]), encased in a clear, oil-filled tube, was attached to the sides of the extension ahead of the grate in a pattern that went from low at the forward end to high at the aft. Pollock that followed this pattern would move upward as they passed back toward the grate.

A small-mesh cover was installed over the grate to capture escaping fish and route them to a secondary codend for enumeration. Floats, rigid rods and support lines were installed on the cover so that it did not mask the opening.

The volume of the catch from each codend was determined from measurements after it was released into a rectangular bin. When large sharks were captured, they were removed before the volume measurements were taken. If discovered after measurement, the volume of these sharks was estimated and subtracted from the pollock catch estimate. A sample of each catch was collected by inserting baskets at intervals into the flow of fish as they entered the hold. The volume of each sample (averaging about 0.25 m^3) was determined by measurements taken when it was placed in a smaller rectangular bin. The ratio of catch and sample volumes was used to expand the sample numbers to estimate the number of pollock of each length in the whole catch.

The fork lengths of all pollock in the samples were measured to the nearest cm to determine size compositions. Individuals representing a range of sizes of pollock, rock sole and halibut were selected for width and weight measurements. Width was measured with calipers near the back edge of the preoperculum, the widest point that could not be easily compressed. These measurements were taken to allow a comparison of the grate spacing to the appropriate dimensions of the fish that passed through it.

Selectivity was analyzed by comparing the number of pollock at each length interval in the main codend to those in the main and

"escape" codends combined, giving an estimate of the percent retained for each length group. The values for each haul were fit to a logistic model to provide an equation for the percent retained as a function of fish length. Key parameters from those equations included the L_{50}, the length at which 50% of the fish are retained and the selection range, the difference between the L_{75} and the L_{25}.

RESULTS

Forty-four experimental tows were completed off of the east side of Kodiak Island, Alaska, between Cape Barnabas and North Cape. Average towing depth, light level and temperature were 113 m, 2.6 X 10^{-5} microEinsteins/sec/m^2 and 4.9 degrees Celsius. Operating height of the study trawl averaged 18.3 m (10 fm) and average towing speed was 3.5 knots. Catch rates averaged 4.3 mt/hr. A total of 140 metric tons (mt) of pollock were caught. Bycatch was very low, with the principal components being 26 pacific sleeper sharks, 5 salmon sharks and less than one mt of arrowtooth flounder. Approximately 50 hours of video were collected on the behavior and rate of encounter of pollock with the grates.

Grates

The fiberglass grates went on and off of the net reel easily. The most significant handling problems involved the cover net and additional codend. Some damage to the grates did occur. When floats for deflector panel support went onto the reel under the grate, they forced some bars to bend over them. This caused many of those bars to split. This problem was alleviated by moving the floats and/or using stretch cords to support the diverter panel. The 1.6 cm cross rods were broken on a few occasions while bringing the net aboard, when the net was constricted with a hauling strap too close to the grate. The shape of the grate openings remained consistent throughout the tests. Gilling of fish in the grates was rare.

Video observations confirmed that the grates were not masked by the cover mesh and that fish moved through them unimpeded. The cover was at least 2 meters above the grate itself, so it was unlikely that it was a significant visual stimulus compared to the grate itself. The grate itself fished at an angle of 20-25 degrees from the horizontal.

Pollock Selection

The pollock encountered were nearly all longer than 35 cm with a

very strong mode at 44 cm (Figure 1). The low occurrence of
pollock smaller than commercial size necessitated use of wider
bar spacings than might be useful for the commercial fishery. A
narrower grate size would have resulted in full retention of
nearly all of the fish available.

Figure 4 shows the selection pattern for the grates. This
pattern did not change significantly over a range of small
adjustments, including the bar spacing difference (51 vs. 53 mm)
between the grates. The length at which 50% of the pollock were
retained was around 40 cm.

Measurements on 606 pollock showed that head width was directly
related to length (Figure 3) and that 54 cm pollock had head
widths approximately equal to the bar spacing. That about 95% of
pollock that length were retained confirmed that retention
approaches 100% as the head width nears the bar spacing. Figure
4 shows the results of 638 pollock length and weight
measurements.

SCIENTIFIC PERSONNEL

1.   Craig Rose   AFSC   Chief Scientist
2.   Scott McEntire   AFSC   Fisheries Biologist
3.   Erica Acuna   AFSC   Biological Technician
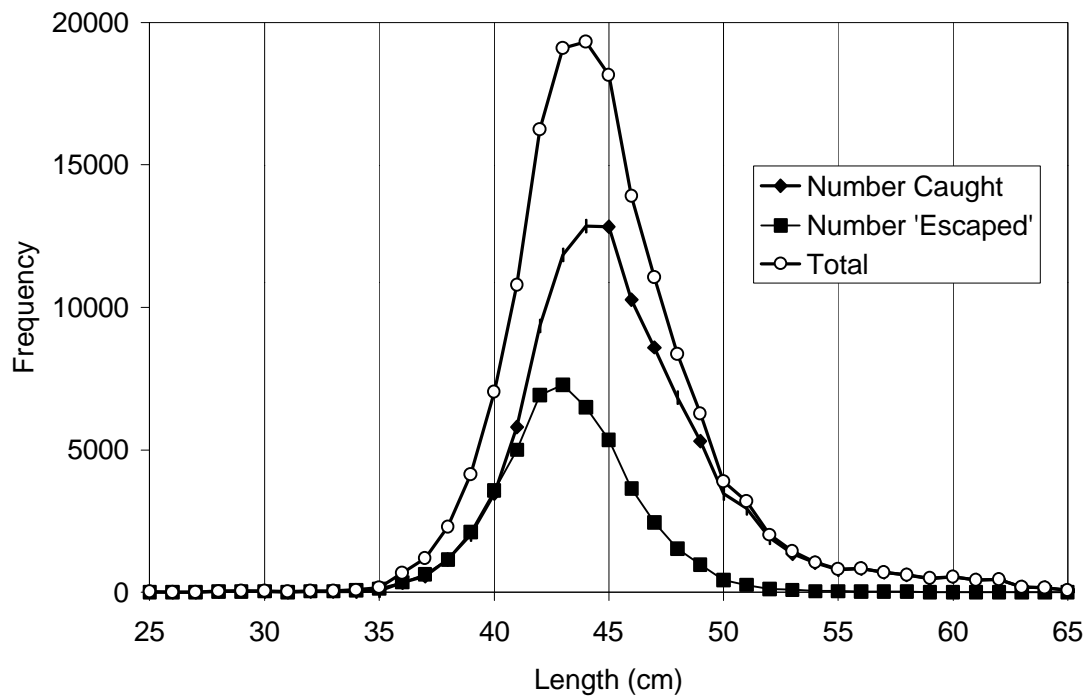
AFSC - Alaska Fisheries Science Center, NMFS

Figure 1 - Size composition of pollock during selectivity study
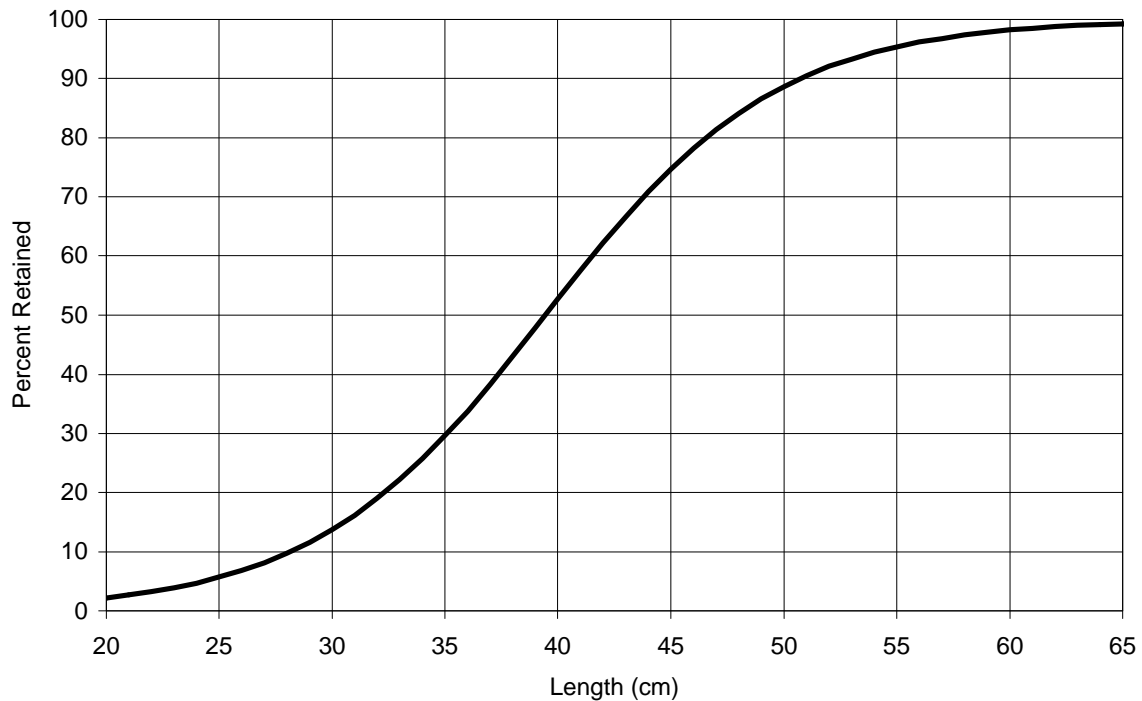

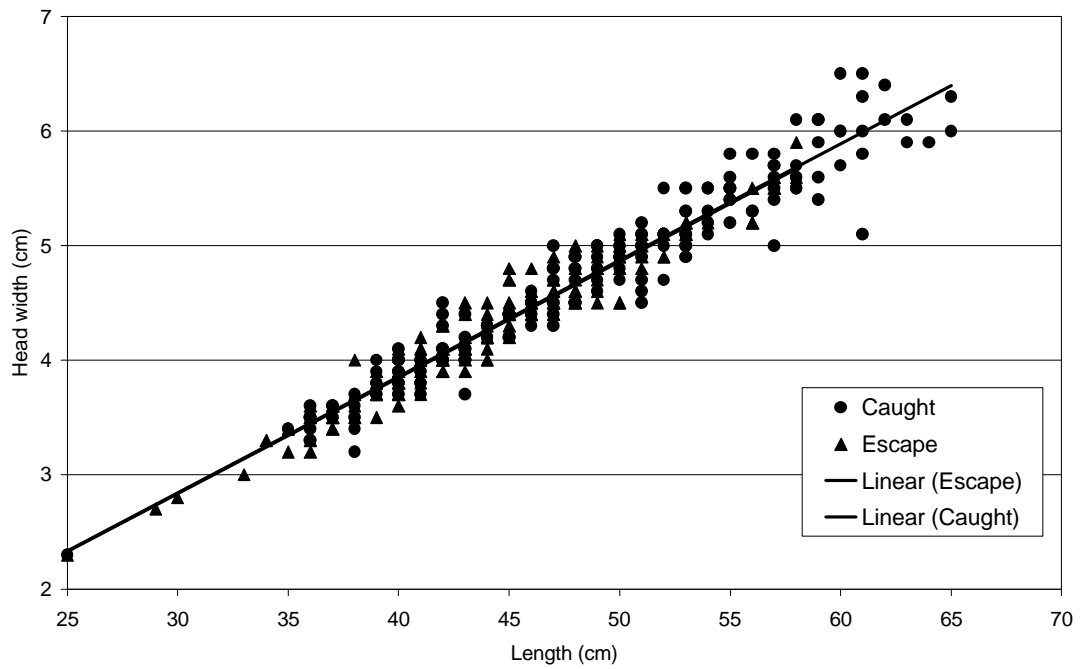Figure 2 - Size Selection of Pollock using a Flexible Grate

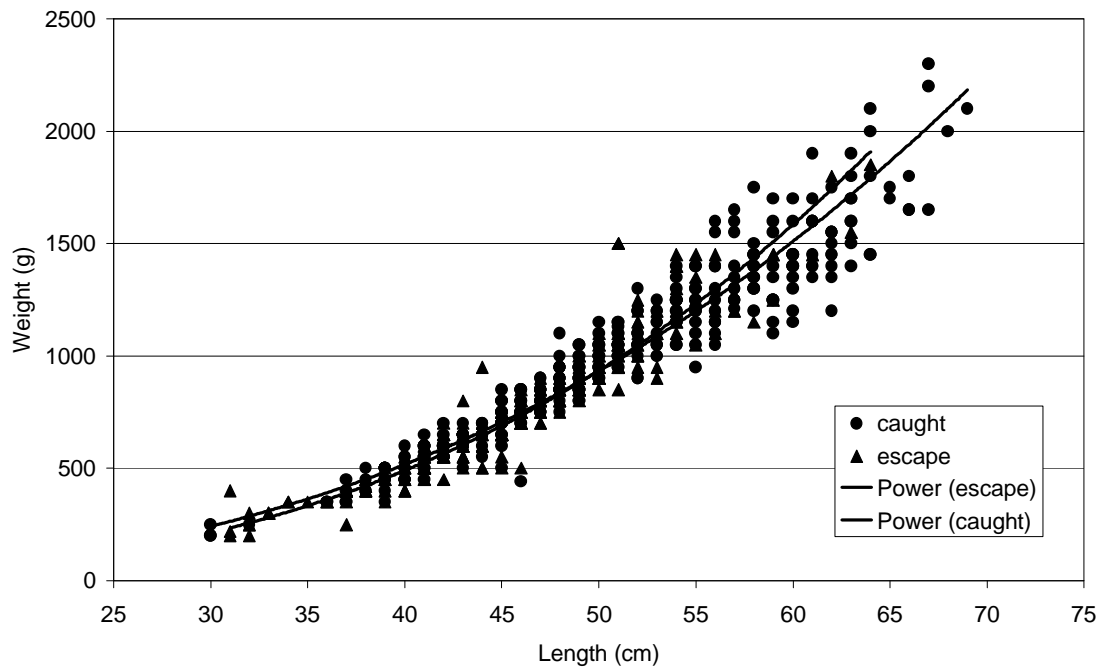Figure 3 - Length - head width relationship for walleye pollock

Figure 4 - Length - weight relationship for walleye pollock